Historic, archived document

Do not assume content reflects current scientific knowledge, policies, or practices.

1.9622
C3T222

TECHNICAL PAPER
CENTRAL STATES FOREST EXPERIMENT STATION
COLUMBUS 15, OHIO

RECEIVED
DEPARTMENT OF AGRICULTURE

No. 139 December 1953

HOW THINNING INFLUENCES GROWTH OF PIN OAK

U.S.D.A., NAL
JUN 23 2008
CATALOGING PREP

by

Leon S. Minckler[1]

Pin oak (Quercus palustris Muenchh.) usually occurs on poorly drained, heavy-textured, bottom-land soils over a wide range including the Central and Middle Atlantic States. Although this species is often a component of bottom-land hardwoods, it more commonly occurs as nearly pure, even-aged stands called "pin oak flats." According to the recent Forest Survey[2] there are nearly a million acres of pin oak flats in Illinois, Indiana, and Missouri. In addition, Ohio, Kentucky, and Iowa probably contain more than half a million acres of this type.

Pin oak is used for piling, mine props, and posts or ties (if treated). It is also used for lumber and dimension stock where knots are not objectionable. Perhaps because of its relatively low value for lumber, the silviculture and management of the species have received very little attention.

The chief objective of the study reported here is to determine the intensity of thinning and the resulting stocking that yield the most forest products. As the first step, a series of thinning treatments in pin oak was established in southern Illinois in the spring of 1949.

1/ Silviculturist, Carbondale Research Center (Maintained in cooperation with Southern Illinois University). The author wishes to thank personnel of the Jonesboro Ranger District, Shawnee National Forest, for assistance in conducting this study.

2/ Forest Survey Organization, Central States Forest Experiment Station: Forest resources of Missouri. Forest Survey Release 6, 19 pp. 1948; Forest resources of Illinois. Forest Survey Release 7, 53 pp. 1949; Forest statistics of Indiana. Forest Survey Release 15, 36 pp. 1953.

METHODS

The study plots were laid out in the Shawnee National Forest in a nearly pure, even-aged stand of pin oak in the Mississippi flood plain. The number of dead trees, the narrow crowns, and the nearly barren forest floor all showed that the stands were overstocked. At the beginning of the experiment, the stands were 37 years old and the dominant trees were about 70 feet high. At that time, 84 percent of the trees on the plots were pin oak, 10 percent were cherry bark oak (*Quercus falcata* var. *pagodaefolia* Ell.), and 6 percent were miscellaneous species, mostly swamp white oak (*Quercus bicolor* Willd.). The site is flat and poorly drained with a tight clay subsoil. Flooding during the winter and spring months is common but a single flood seldom lasts longer than a week or 10 days.

Eight 4/10-acre square plots 33 feet apart were laid out in the stand: 3 were thinned to about 65 square feet basal area (heavy thinning), 3 were thinned to about 75 square feet (medium thinning), and 2 were thinned to about 90 square feet (salvage thinning) (table 1). The salvage-cut stands were considered to be check plots since only trees of exceptionally low vigor were cut.

Table 1.--Original stand, amount cut, and 4-year net growth of pin oak stands by intensity of thinning

(Averages per 4/10-acre plot)

Intensity of thinning	Original stand		Amount cut		Net growth 1/		
	Basal area 2/	Volume 3/	Basal area	Volume	Basal area	Volume 4/	
	Square feet	Cubic feet	Square feet	Cubic feet	Square feet	Cubic feet	Board-feet
Heavy	91.3	1,481	26.5	446	15.7	505	1,472
Medium	99.2	1,622	22.8	381	7.7	255	2,043
Salvage	101.2	1,550	10.0	155	2.3	223	1,214

1/ Present stands minus residual stands.

2/ Basal area of all live trees 1 inch d.b.h. and larger.

3/ Volume of all live trees 4.6 inches d.b.h. and larger which have at least one 8-foot piece to a 3-inch top inside bark, form class 75.

4/ Board-foot volume includes volume of all live trees 10.6 inches d.b.h. and larger, International 1/4-inch rule, form class 78.

Note: See Appendix, p. 8, for more detailed tables.

The first inventory for this study was made in the spring of 1949; the final inventory was made in the fall of 1952.[3] However, although the growth during the 4 intervening growing seasons is reported and discussed here, the thinning was not done until the fall of 1949 (Shawnee National Forest timber sale). This left but 3 growing seasons in which the stands could respond to the thinning. The differences in growth stimulated by the three intensities of thinning are thus somewhat tempered.

The merchantable heights of trees less than 10.6 inches d.b.h. were estimated to a 3-inch top inside bark. Height estimates in the second inventory were carefully checked with an Abney level and these were used in calculating all cubic-foot volumes. The mean merchantable heights by diameter classes and the corresponding volumes, as determined by the 1952 inventory, are as follows:

Diameter breast high (inches)	Mean merchantable height (feet)	Cubic-foot volume (form class 75)[4]
5	12.0	1.30
6	24.1	2.90
7	34.0	4.85
8	40.0	7.10
9	44.8	9.70
10	46.4	11.60

Merchantable heights of trees 10.6 inches d.b.h. and larger were estimated to the nearest half log according to Mesavage and Girard's form class volume tables.[5] Both the basal-area and volume data, therefore, are comparable for the original, residual, and present stands.

Thinning was done to eliminate the poorer trees, and to attain reasonably uniform spacing. In general, the heavier the thinning, the better the quality of the resulting residual stand.

RESULTS

Differences in stands thinned at high and low intensities are fairly plain to see on the ground (figs. 1 and 2). Holes created in the canopy by the heavy thinning have virtually closed

---

3/ All plots were burned over on October 31, 1952, but the extent of damage has not yet been determined (figs. 1 and 2).

4/ Mesavage, Clement. Tables for estimating cubic-foot volume of timber. Southern Forest Experiment Station, Occasional Paper No. 111. 1947.

5/ Mesavage, Clement, and Girard, James W. Tables for estimating board foot volume of timber. U. S. Forest Service, 1946.

Figure 1.--Salvage-cut pin oak stand 3 years after thinning. Plot was thinned from 100 to 92 square feet basal area per acre. During the growth period mortality exceeded growth and the present basal area is 91 square feet. Fire in October 1952 eliminated most of the already sparse underbrush. An old water line is plainly visible on the trees.

Figure 2.--Heavy-cut pin oak stand 3 years after thinning. Plot was thinned from 83 to 63 square feet basal area per acre. The present basal area is 76 square feet. Fire in October 1952 eliminated most of the underbrush.

and the tree crowns are well developed. The crown canopy of the salvage-cut stands is also closed but the average crown width is less than on the more heavily thinned plots. There are many more intermediate and suppressed trees on plots given the lighter thinnings.

Growth as Related to Thinning Treatment

The results show sharp differences in growth, depending upon the thinning treatment used. The heavy-cut plots made about twice as much net basal-area and cubic-volume growth as the medium-cut plots. The salvage- or light-cut plots made the least net growth of any of the treatments (fig. 3 and table 1).

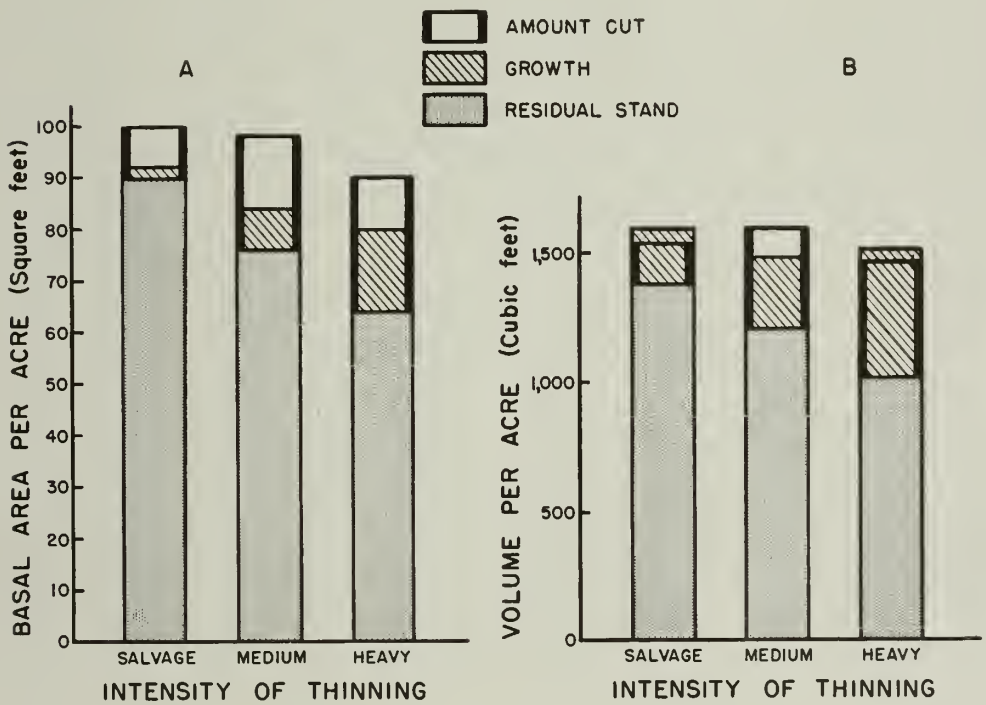

Figure 3.--Cut, growth, residual, and present basal areas and volumes of thinned stands.

The present stands, after 4 years growth, have about the same cubic-foot volume as the original stands. Three times more cubic-foot volume was removed from the heavy-cut than from the salvage-cut plots; yet, at the end of 4 years, the total volumes for these stands had approximately the same relationship to each other as before cutting. If net growth is added to the amount cut, the heavy-, medium-, and salvage-cut treatments produced 951, 636, and 378 cubic feet of merchantable material per acre. This is roughly equivalent to 1189, 795, and 473 8-foot mine props for the three cutting treatments.

The medium-cut plots grew fastest in board-feet--511 board-feet per acre per year. The heavy-cut plots grew 368 and the salvage-cut plots 303 board-feet per acre per year. It is too early to evaluate board-foot growth because so much of it is ingrowth and depends largely upon the diameter distribution in the stands. The medium-cut plots gained 22 sawtimber-sized trees per acre in the 4-year period while the heavy-cut and salvage-cut plots gained 18 and 15, respectively (table 4 - Appendix).

Mortality

The mortality for the 4-year period was 6.4, 8.0, and 16.8 square feet of basal area per acre for the heavy-, medium-, and salvage-cut plots. No uncut stands were measured but mortality would probably have been higher in these than in the salvage-cut plots. Mortality could have caused most of the difference in net basal-area growth between the salvage-cut and the other treatments; it could also have caused some of the difference in basal-area growth between the medium- and heavy-cut plots. However, a good part of the volume growth differences between treatments must be ascribed to faster growth on the better trees left in the more heavily thinned stands because much of the mortality occurred in small trees (4 inches d.b.h. or less) that contained no merchantable volume.

Change in Diameter Distribution

The amazingly rapid change in diameter distribution in only 4 years shows the dynamic nature of a young, vigorous, pin oak stand (table 4 - Appendix). Tree sizes increased sharply, accompanied by a loss in total number of trees. The heavy-, medium-, and salvage-cut plots lost a total of 71, 97, and 168 trees per acre, respectively, in the 4-year period. Gains were made in numbers of trees 8 inches in diameter and larger for all treatments. Only the heavy-cut plots gained trees in the 5-inch-and-larger class. The medium-cut plots made the greatest gain in sawtimber-sized trees.

APPLICATION OF RESULTS TO MANAGEMENT PRACTICE

The results of this study have practical application in the management of pin oak for the production of props, posts, piling, and perhaps sawtimber. The number of trees lost in 4 years strongly indicate that mortality was rather heavy before the plots were established. Earlier thinnings would have salvaged some of these trees and at the same time would have stimulated growth on the better trees that were left. Frequent thinnings seem to be possible and desirable. Such thinning practice would increase the yield of small products and should, at the same time, shorten the rotation

for piling or sawtimber. The total yield of piling for one rotation would also be greater because the heavy thinnings would give the best trees room to grow.

NATIONAL AGRICULTURAL LIBRARY
1022500812

In considering growth response to thinning and mortality in relation to stocking, pin oak probably behaves as it does partly because it is such an intolerant species and partly because it usually has enough moisture for good growth. Pin oak is relatively intolerant and requires nearly full light on a large part of the crown for good growth. It also requires ample moisture but will thrive on poorly drained sites with tight subsoils. Successful even-aged reproduction usually occurs on old fields, clear-cut areas, or in large openings in the stand.

The chief disadvantage of pin oak for lumber is the abundance of small "pin" knots caused by the profusion of small branches along the trunk. Although dead, these branches persist for many years. Unless pruned, open-grown trees are usually a mass of branches all the way to the ground. Two important management objectives (even for props or piling) are (1) to obtain the greatest amount of natural pruning at early ages and (2) to get the maximum growth on the crop trees after pruning. To accomplish this, pin oak probably should be grown in dense, even-aged stands until the trees have 25-40 feet of trunk length to the live crown. The best length will depend on the site and the products desired. As soon as possible thereafter, the stand should be thinned to obtain greater growth on the better trees.

In view of these pin oak characteristics and the present growth results, the first thinning should be made between 20 and 30 years of age, depending upon site quality, stand density, and mortality. Subsequent thinnings can probably be made every 4 to 8 years. On the basis of the study reported here, a previously unmanaged, 35-year-old pin oak stand should be thinned to at least 65 square feet basal area or 1,000 cubic feet of volume, leaving the best potential piling and sawtimber trees for growing stock.

NATIONAL AGRICULTURAL LIBRARY
[redacted]
1022500912

APPENDIX

Table 2.--Basal area, total volume, and sawtimber volume per acre for pin oak by intensity of thinning

Intensity of thinning	Plot No.	Basal area[1] (square feet)			Total volume[2] (cubic feet)			Sawtimber volume[3] (board-feet)	
		Original stand	Residual stand	Present stand[4]	Original stand	Residual stand	Present stand	Residual stand	Present stand
Heavy	1	82.6	63.2	76.4	1341	1021	1392	988	2617
	3	83.2	64.4	86.6	1475	1140	1716	670	2163
	8	108.2	66.9	78.6	1627	945	1515	0	1295
	Means	91.3	64.8	80.5	1481	1035	1541	553	2025
Medium	2	100.2	77.2	86.0	1784	1384	1567	1738	4330
	5	96.2	79.6	82.0	1546	1248	1496	168	1750
	6	101.1	72.3	84.2	1536	1092	1425	1950	3903
	Means	99.2	76.4	84.1	1622	1241	1496	1285	3328
Salvage	4	99.8	91.6	90.5	1607	1484	1715	0	1415
	7	102.6	90.9	96.5	1492	1306	1522	2298	3310
	Means	101.2	91.2	93.5	1550	1395	1619	1149	2363

1/ All live trees 1 inch d.b.h. and over.
2/ All live trees 4.6 inches d.b.h. and over which have at least an 8-foot piece to a 3-inch top (inside bark), form class 75.
3/ All live trees 10.6 inches d.b.h. and over; International Rule, form class 78.
4/ Growth period 4 years; stand age 37 to 41.

Table 3.--Amount cut and growth in 4 years per acre by intensity of thinning

Intensity of thinning	Plot No.	Basal area (square feet)		Cubic-foot volume		Sawtimber volume (board-feet)
		Net growth 4 years[1]	Amount cut[2]	Net growth 4 years	Amount cut	Net growth 4 years
Heavy	1	13.2	19.4	371	320	1629
	3	22.2	18.8	576	335	1493
	8	11.7	41.3	570	682	1295
	Means	15.7	26.5	505	446	1472
Medium	2	8.8	23.0	183	400	2592
	5	2.4	16.6	248	298	1582
	6	11.8	28.8	333	444	1953
	Means	7.7	22.8	255	381	2043
Salvage	4	-1.1	8.2	231	123	1415
	7	5.6	11.7	216	186	1012
	Means	2.3	10.0	223	155	1214

1/ Present minus residual stands, table 2.
2/ Original minus residual stands, table 2.

Table 4.--Average number of trees per acre in residual and present stands by diameter class

Diameter class (inches)	Heavy-thinned stands			Medium-thinned stands			Salvage-thinned stands		
	Residual	Present	Difference	Residual	Present	Difference	Residual	Present	Difference
1-4	121	24	-97	140	56	-84	227	71	-156
5-7	116	99	-17	128	87	-41	175	125	- 50
8-10	66	91	+25	75	81	+ 6	78	101	+ 23
11-13	7	23	+16	15	35	+20	9	23	+ 14
14-17	0	2	+ 2	1	3	+ 2	4	5	+ 1
Total	310	239	-71	359	262	-97	493	325	-168
5 and larger	189	215	+26	219	206	-13	266	254	- 12
8 and larger	73	116	+43	91	119	+28	91	129	+ 38